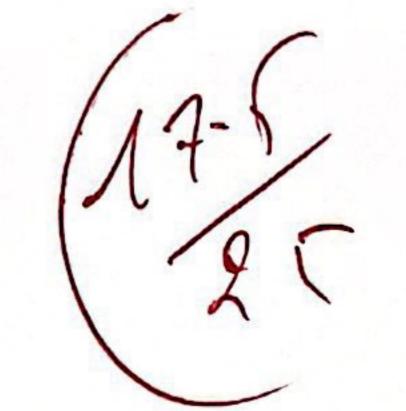
KING SAUD UNIVERSITY

COLLEGE OF COMPUTER & INFORMATION SCIENCES DEPT OF COMPUTER SCIENCE



CSC311 Computer Algorithms

Third Semester 1444 AH

Mid-term Examination: Instructors:

(Spring 2023)

Wed 10.05.2023 C.E. (duration = 1:30 hours) Prof Aqil M. Azmi + Prof M. Maher Ben Ismail

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1. [Marks 5] 3.

Give a suitable big-O, big- Ω , small-o, and small-w for each of the following (n is the size of the input problem).

		Big-O	Big-Ω	small-o	small-w
(a)	$\log n + 10000$	o(logn)	alogn).	10(n)	14 10 10 V
(b)	$n \log n + 15n + 0.002n^2$	0(~109)	26 1092	0(n2) N	₹ w(rogn)
(c)	$37n + \sqrt{n}$	0(n)	2(n) 1	0 (100gg) V	w(1091)
(d)	$1000n^2 + 17n + 2^n$	0(n2)	TC(n2)X	0(3)	w(h)
(e)	$2^{10} + 3^{5}$	0(1)	2(1)	o(\$)	w(I)

2. [Marks 3] 1/3

What is the value of C and n_0 such that $0.01n \log n + 200n + 6 \in \Omega(n \log n)$.

0,01 nlogn+200n+6 7/ nlogn

$$c \neq 1$$

$$n_s = \frac{k^2 d_k}{a_k - c_k}$$

$$= \frac{206/01}{0/01-1} = .208$$

3. [Marks 5]

Consider the code fragment, $x \mapsto 5$ if (i is divisible by 3) $x \mapsto x + i$ print x(a) Express the value of x as a function of N: and (b) What is x if N = 302. $x \mapsto 5$ $x \mapsto 5$ (a) Express the value of x as a function of N: and (b) What is x if N = 302.

b)
$$30^{2/3} + 300$$

 $5 + \sum_{i=1}^{3} (3(i-1)) = 134555$

4. [Marks 3] 3/3
Solve the recurrence relation using the repeated substitution method,

$$T(n) = \begin{cases} 4T(n/3) + 2n, & n > 1 \\ c, & n = 1. \end{cases}$$

K-1 K (2/3) m

1= \$ U x 20

$$= 24\left[4T\left(\frac{5}{3^2}\right) + \frac{27}{3}\right] + 2n = 4^2T\left(\frac{5}{3^2}\right) + \frac{8}{3}n + 2n$$

=>
$$4^{2}\left[4T\left(\frac{5}{3}\right)+\frac{2n}{3^{2}}\right]+\frac{8}{3}n+2n = 4T\left(\frac{5}{3}\right)+4^{2}x^{\frac{2}{3}}n+4y^{\frac{2}{3}}n+2n$$

Stop when =
$$3k = 1$$
 = $3n = 3^k = 5k = 1093$

5. [Marks 4] Solve the following recurrences using the Master theorem by giving tight θ -notation bounds. Justify your answers. The Master theorem is: T(n) = aT(n/b) + f(n),

If
$$f(n) \in \Theta(n^d)$$
, where $d \ge 0$, then $T(n) \in \begin{cases} \Theta(n^d), & \text{if } a < b^d, \\ \Theta(n^d \log n), & \text{if } a = b^d, \\ \Theta(n^{\log_b a}), & \text{if } a > b^d. \end{cases}$

Another master theorem is given by $h(n) = f(n) / n^{\log_b a}$, then

$$T(n) \in \begin{cases} O(n^{\log_b a}), & \text{if } h(n) = O(n^r), r < 0, \\ \Theta(n^{\log_b a} \log^{k+1} n), & \text{if } h(n) = \Theta(\log^k n), k \ge 0, \\ O(f(n), & \text{if } h(n) = \Omega(n^r), r > 0. \end{cases}$$

(a)
$$T(n) = 4T(n/4) + 5 log^2(n)$$

(b)
$$T(n) = 9T(n/3) + 3n^2$$

$$0.9, 6=3, f(n)=3n^2$$

$$3n^2 = n^2$$

(c)
$$T(n) = 7T(n/2) + n^3 \log n$$

6. [Marks 5] Given an array A of size n. The array (a) Give the best algorithm you can array A is not sorted. (b) Analyze its example, the list [3, 5, 0, 2, 1] is miss	contains all but one of the integers from 0 to n. to determine which number is missing if the asymptotic worst-case running time. For sing the number 4.
Fint Miss (A [o us]	
For to me Handing	
a) Fax	
find miss (Alone) { for its int it Cxt=Alryde x++2 yetan 2 notan 2	Find miss (A[on]) { X & o Fot i & o o & { if (x! = A E i]) } Remarkt else
b) in worst case missing number w	rast index, so it will loop in entire
array $= 0(n)$	